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ABSTRACT

Included in this publication are reviews of research related to: (1) concepts and programs, (2) curriculum and programs, (3) simulations, gaming and modeling, (4) attitudes, (5) evaluation, (6) teacher attitudes, (7) teacher education, (8) camp programs, (9) administration, (10) facilities and sites, (11) environmental communications, and (12) recommendations. Past and current research is identified, summarized, and analyzed. In addition, areas in need of research and possible research designs are discussed. (RH)

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A REVIEW OF RESEARCH RELATED TO ENVIRONMENTAL EDUCATION, 1973-1976

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Robert E. Roth

I. Introduction

The continued development and strengthening of environmental education programs depends to a great extent upon the evaluation of such programs. There exists a clear need for an increase in the sophistication of methods and techniques utilized in empirical research involving environmental education. The purpose of this review is to: (1) summarize accomplishments since the publication of A Review of Research Related to Environmental Education in 1972 and (2) determine areas appropriate for further study in environmental education.

As we begin to realize the complexity of environmental problems, we must develop sophistication of methods and techniques in research appropriate to coping realistically with the understanding of such problems. In a review of literature and research in the field of environmental education conducted by Hendee (1972), a lack of rigorous empirical research in environmental education was noted. He suggested, "Basic research questions need to be framed and previous work severely analyzed to determine the current extent of empirical knowledge about the effects of environmental education." Hendee made two recommendations for developing a scientific basis for environmental education:

1) To inventory all the claims of the subjective, value-loaded material on environmental programs as to the effects of such activity that are stated, suggested, or implied. These should be rephrased into propositions and hypotheses which would form a valuable focus for subsequent empirical research;

2) To develop an inventory of previous studies and rigorously evaluate their validity, reliability, and substance.

In this review of environmental education research the writer attempts to:

1) define areas in which little research has been or is being conducted;

2) briefly evaluate currently used research strategies in order to specify additional research approaches; and

3) suggest new and/or different areas in which research in environmental education should be conducted.

II. Environmental Education Concepts and Programs

The first attempts to develop environmental education programs included work done earlier in the era of conservation education. Since that time considerable effort has been expended in developing a research base on a variety of fronts in environmental education. Gustafson (1972) stated that:

> "Education is a three-dimensional thing. The most obvious dimension is content, the simple transfer of information either from person to person directly or through various media. Most of the time we attempt to go to a second dimension, the concept. We recognize that knowing many facts is pointless unless these facts are integrated into meaningful generalization. What we generally fail to realize is that education has failed if it does not result in changed behavior - and changed behavior comes only through a third dimension, conscience."

Concepts isolate common attributes of objects, events, and behavior, allowing one to make associations. The emphasis is on "understanding," "acquiring," "becoming aware," and "helping to understand." In short, concepts serve as an integrative mechanism, drawing together threads of similarity. A variety of studies dealing with concept formulation appropriate for various facets of the interdisciplinary area of environmental education are described below.

Ronfeldt (1969) established a list of urban environmental understandings for inclusion in elementary school curricula. He was assisted in this identification by 90 elementary teachers and conservationists. Of the 104 understandings pulled from published materials, the panel identified 98 as important and 43 were recognized as both important and basic to knowledge of the urban environment. The respondents agreed that urban environmental education should be integrated with existing disciplines rather than established as a separate one.

Roth, Pella, and Schoenfeld (1970) reported on a list of environmental management concepts derived from the earlier dissertation work of Roth (1969). They traced the development of the environmental movement beginning with the nature study and conservation education programs of previous decades. A taxonomy of 111 concepts appropriate for environmental management education was divided into fourteen categories with the number of concepts in each category specified in parentheses: environmental management (16), management techniques (8), economics (18), environmental problems (3), environmental ecology (8), adaptation and evolution (9), natural resources (13), socio-cultural environment (10), culture (4), politics (5), the family (1), the individual (6), and psychological aspects (4). The underlined categories are those which include concepts selected by K-12 teachers as important and suitable for introduction in grades K-6.

Horn (1972) attempted to determine whether or not a significant correlation existed between the ranking of a list of environmental management concepts by a national panel of scholars participating in Roth's study (1969), as compared with a group of thirty-one kindergarten through eighth grade teachers attending an environmental education workshop at the University of South Dakota. From each of the major areas, (1) Environmental Management, (2) Management Techniques, (3) Economics, (4) Environmental Ecology, (5) Natural Resources, (6) The Socio-Cultural Environment, and (7) Man and the Family, six concepts were chosen. The teachers participating in the study were asked to rank the concepts in each category from most to least important. Relative to this study, the teachers did not agree significantly on those concepts ranked highest by the national panel of scholars. A correlation of only .05 existed in the Natural Resources area. As a general conclusion based on the results of this study, a strong disagreement exists as to the relative importance of the individual environmental concepts. This disagreement exists between the national panel and the group of elementary and middle school teachers, as well as within this particular group of teachers. The sample used in Horn's study was relatively small and clustered, which may have caused some of the disagreement.

Roth and Helgeson (1972) reviewed and summarized the research related to environmental education through 1972. They examined the philosophy and goals of environmental education and discussed both instructional and administrative concerns relative to environmental education. It was suggested that more effort was needed in the development of conceptual structures, scope, and sequence in the area of curriculum development and in the integration of key concepts from the sciences, social sciences and humanities into environmental education. They supported the idea that conservation and outdoor education presented too narrow a viewpoint:

> Environmental concerns clearly require educational materials that deal with the interrelationships and with the interactions of living things with the environment and which draw upon knowledge and understanding from all areas of the natural, physical and social sciences (p. 25).

Lucas (1972) concerned himself with the implications of education in, about and for (the preservation of) the environment. He suggested that education in the environment is primarily a pedagogic technique; education about the environment produces a knowledgeable individual; and education for the environment is intended to increase the chances of development and maintenance of an environment conducive to individual well-being or a "quality life." An interdisciplinary approach is also supported by Lucas' study.

The concept of environment was also examined by Austin (1974). A series of questions about the environment was structured and applied to educational theory and environmental education. The questions are of a philosophical nature, yet provide an essential first step in providing a total picture of environmental education. It was determined that the concept of environment was confused in usage in the areas of conceptual, empirical, and educational research.

Isabell (1972) identified concepts which could be of use in the development of instructional materials for environmental education. The nine concepts identified were ecologically oriented and concerned the functioning and stability of an ecosystem. He also considered selected human applications of the concepts and supported an interdisciplinary orientation of environmental education.

Peden (1972) developed and tested an interdisciplinary environmental education unit for seventh graders. The purposes of the study were to:

1) develop a three-week interdisciplinary environmental educational unit;

2) implement that unit in a classroom situation; and

3) determine the educational value.

The unit was determined to be effective, by utilizing a t-test of pre- and post-test data. The unit did teach content to high, average, and low ability students and both students and instructors expressed a positive response toward the unit. Even though the testing took place in a single school district in South Carolina during May 1972 only, the results were generally interpreted to be favorable.

Allman (1972) identified 113 concepts to be included in elementary environmental education curricula. The list was developed by surveying a national sample of education and curriculum specialists considered to be experts in the field. Conclusions by Allman emphasized the multi-disciplinary nature of environmental education, integrating many content areas, and the idea that the concepts identified may be presented at any grade level. It was recommended that the classroom teacher be the one who selects the concepts to be taught in class.

Marlett (1972) surveyed secondary students from southern Texas to Nebraska on selected environmental concepts. His instrument's reliability was tested using a split half correlation corrected by the Spearman-Brown formula; a coefficient of reliability of .91 was obtained. A positive correlation was found between the mean scores of students and a national panel of scholars. No statistically significant differences were found between students grouped by residence, declared background environment, age or sex, in a one-way analysis of variance.

Studies by Arganian (1972) and Boone (1972) were concerned with the effects of age, grade, and sex as they influenced acquisition of environmental concepts. Arganian was interested in discovering if students in the middle elementary grades would be able to learn the concepts, "biodegradable agent," "biodegradable material," and biodegradable process" from a short written lesson. A twelve-item testing instrument was developed and a strong research design, the Solomon Four Group, utilized, with replication at the fourth and sixth grade levels. The short written lesson proved to be helpful in student learning of the concepts, and they retained a significant amount of the material for a three-month period.

Boone (1972) examined sex, grade, and concern level of seventh graders to determine whether or not these were critical factors in the assignment of importance to environmental concept statements. Simulations and non-use of simulations were also compared. In addition, Boone sought to determine if the responses of junior high students paralleled those of an environmentally concerned adult population. All factors were found to be of value in the assignment of importance to environmental concepts. Simulation treatment resulted in higher assignment of importance to the concepts. Also, the pattern of responses of junior high students to environmental concept statements was found to be similar to that of an environmentally concerned adult population.

Dorsey (1972) surveyed the comparative status of understanding and reasoning in conservation concepts and principles held by ninth graders in South Carolina's public schools. Two forms of a test of reasoning in conservation were given to students in 48 schools. Subpopulations were established utilizing the following criteria: sex; percent minority enrollment of school; size of school (greater or less than 650 enrollment) and type of school district (rural--less than 10,000, suburban--less than 40,000, urban--over 100,000). Analysis of data identified some significant differences among the subpopulations. Applications of t-tests showed no significant differences between suburban and urban schools while both scored significantly higher than rural schools. Large schools scored slightly higher than small schools, and students from schools with a large minority group population scored lower than students from non-minority schools. Males scored higher than females.

It was concluded that students' understanding and reasoning in concepts and principles of conservation do differ when related to school location, school size, race predominance in school enrollment, and sex of subjects. Reasons for these differences were not specified, but recommendations for program development for increased emphasis upon economic, sociological, and human aspects of conservation were given.

Blinn (1972) investigated components of urban environmental education, examining the aesthetics of an urban environment and the effects upon the student. A gap between what was being taught and a curriculum developed by consulting experts was described. Concepts to be used in solving urban problems were found to be absent and it was suggested that before such concepts could be identified urban experts must provide a set of criteria on which to base the search.

Walser (1973) reviewed existing programs in North Carolina and available curricular guides. A resource guide, organized in four parts (K-3, 4-6, 7-9, 10-12) including sample lessons, was developed. It was heavily oriented toward use in North Carolina in that it referred users to the available services provided by North Carolina agencies.

Rentsch (1973) produced An Instrument to Measure the Minimal Understanding and Knowledge Possession Levels in Ten Environmental Concept Categories of an Environmentally Literate Citizenry. The subjects of the research were 80 female preservice elementary education students at the

University of Michigan. The instrument was designed with the aid of a panel knowledgeable in the area of environmental education. Ten concept areas with twenty-nine components were identified for minimal environmental literacy. This instrument, measuring understanding level of environmental concepts and possession level of knowledge of facts, organization, and abstractions, was found to have a Kuder-Richardson reliability index of 0.79 and a Johnson item discrimination index of 0.31. The results of the test, using the eighty subjects, indicated that the minimal criterion of 90% of the population getting 50% of the items correct was not met. The percentage getting 50% of the answers right for each category ranged from 83% to 32%. Rentsch suggested that the test be used to identify the environmental literacy level of a teacher education school's faculty and student body and that appropriate steps be taken to achieve the 90/50 minimal criterion of an environmentally literate citizenry.

Mangum (1974) dealt with two research topics. First, he examined the methods used in the teaching of ecology in 240 different colleges and universities in the United States using a questionnaire survey. The second aspect involved writing and testing a programmed book pertaining to those aspects of ecology that respondents indicated were insufficiently treated, and were then related to ecological concepts. Based upon data obtained the newly developed material was found to be superior to the old for meeting the specified objectives.

Sparks (1974) developed and field tested a guide book for solid waste education and outlined an 8 to 12 week program using a process approach. Students were actively involved in a community-centered educational task. Four teachers participated, with three content-oriented teachers becoming more process-oriented. An increased awareness of environmental problems relative to solid waste and teacher awareness of process orientation were achieved by this approach.

Summary

Environmental education curricula have been designed as independent courses, as integrative approaches in existing curricula, and as an integration of concepts from existing disciplines into a trans- or interdisciplinary program. These curricula are characterized by a focus on a local situation or a narrow definition of environmentalism. A broad spectrum of consultants has not been utilized in establishing a list of concepts deemed basic to environmental education. A notable exception to this restricting characteristic, according to Schlageter (1975), is Roth's list which was produced through the cooperation of a national panel representing forty disciplines. It is not to the list's advantage that the individuals involved were solely representatives of the university level of education, but this problem is somewhat lessened by the selection of the highest ranking 44 concepts by K-12 teachers for inclusion in K-6 curricula (Horn, 1972). Understanding and knowledge acquisition do differ in relation to many variables ranging from school location to topics taught, but sound program planning will improve the success of environmental education curricula and programs.

III. Curriculum and Program Development

The presence of environmental education in public school curricula can often be characterized by loose organization and little sense of direction. Guidelines for development are often contradictory. Curricula are sometimes implemented for a year and then abandoned when outside funding is no longer available. Some of the courses developed do not really appear to differ significantly from traditional ones.

Although content is important to environmental education, a sound methodology is essential for it to have carry-over value into discrete subject areas. Curriculum development research has been conducted in several areas: methodology, modeling, surveys of existing programs, implementation, and urban aesthetics.

Relating the effects of different approaches or experience, i.e., field trips vs. media, outdoor vs. indoor, provided the focus of studies by Brady (1972), Howie (1974), and Slater (1972). Brady's research dealt with an experimental group of biology students who were taken on field trips, each one designed to reach a single concept, while the control group was exposed to the same environmental concepts through various media. Exposure in both groups lasted for two hours. Evaluation was based upon a comparison of student achievement and environmental attitude data using investigator designed tests. Data were analyzed using t-tests, analysis of variance, and analysis of co-variance. Results indicated significance beyond the 0.1 level between pre-test and post-test scores for both groups, providing evidence that field trips and media can both be used as successful teaching methods in presenting environmental concepts.

Similarly, Slater (1972) utilized an exploratory field trip to analyze its effects upon sixth grade students' cognitive understanding of ecological concepts of adaptation, change, and interdependence, before and after exposure to the field trip. In this study, only one group was used, and it was observed three days before and three days after participating in the field experience. The Campbell and Stanley (1963) Time-Series Design, and the Florida Taxonomy of Cognitive Behavior were used to measure change in cognitive understanding. The Time-Series Design can be useful with classes for there is very little impact on instruction. Results indicated a significant change at the .05 level in the sixth graders' understanding of ecological concepts.

In analyzing Howie's (1974) study in which he examined the effectiveness of outdoor experience vs. classroom experience in relation to control groups, it was found that students who received any one of the three environmental education treatments (outdoors only; indoors only; or outdoor-indoor) were better able to formulate and apply concepts than students in the control group. In developing conceptualization, the classroom experience was found to be more beneficial; however, it was not superior in developing applicability, nor was the indoor-outdoor experience.

Hosley (1974) compared two instructional methods based on the balance of nature concept. The first version utilized field out-of-doors instruction, calling attention to plant and animal interaction, while the other utilized a three-screen slide-tape audio-multiple image (AMI) presentation. The test population of 400 fifth graders was assigned to four treatment groups--the control, receiving no treatment; group II, the AMI treatment; group III, field experience; and group IV, both AMI and field treatment. Results indicated that students who received AMI scored higher on a retention test than those receiving no instruction, and as high as those instructed in field methods. AMI and field experience programs produced higher scores and more rapid responses.

At Elizabeth City State University (1973) in North Carolina, a program strongly student-centered, utilizing competency based instruction, has been developed to prepare students to teach environmental education. Students determine their own academic needs and plan a self-paced program to meet those needs. During this first phase, extensive use is made of audio-visual supported modules. Then students are involved in working with their own individual projects and sharing the results at weekly meetings in the second phase. In addition, each student participates in a summer National Environmental Encounter Workshop, at which time he travels from coast to coast, analyzing and contrasting natural and human environments. After returning, students conduct workshops and seminars with public school teachers, students, and the community, based upon their trip experiences.

A pilot study in communications by Voelker (1973) was made among sixth and seventh grade students from average and low socio-economic neighborhoods in an urban-industrial community, and fifth and sixth graders from a small combined agricultural-industrial community. The material presented consisted of science concepts centered around an environmental problem with accompanying pictorial communications to highlight certain concepts. Pre- and post-tests indicated a number of significant differences between the groups. Child reaction to the sequence in which material was presented seemed to be an important factor in learning capacity.

R. L. Vogl (1973) attempted to determine the willingness of selected school superintendents in Illinois to accept citizen action roles for high school seniors seeking environmental reform and to develop guidelines for such student involvement. Data were collected using Cattell's Sixteen Personality Factor Questionnaire, with superintendents grouped according to size of school. An Environmental Action questionnaire was also developed and administered. Data were analyzed using F-tests, t-tests, and correlations. While statistical differences in data concerning personality traits and environmental issues between large and small schools cast doubt on the results, it was revealed that superintendents appointed from outside the district supported action on air pollution, older, large district superintendents supported action on solid waste disposal and beautification. Small district superintendents supported air and water pollution action. There was a high degree of opinion difference on educational innovation. It was concluded that to assure acceptance, advocates of action roles should view their efforts in the context of diffusion innovation. Similarly, improved environmental behavior of students would enhance their credibility with the public as they attempt to assume action roles.

Jinks (1974) researched an organizational scheme whereby environmental education may be implemented into all major subject matter areas of the school curriculum. It was concluded that the pandisciplinary approach to environmental education is feasible and requires no increase in existing school budgets or staff, nor any reorganization of existing school schedules. A minimal reorientation of instructional focus is required.

Quinn (1973) evaluated a technique for clarifying environmental values with high school sophomores. Thirty-one packets of student materials, called value sheets, were developed on environmental issues. Selected value sheets were evaluated in twenty classrooms. As judged by pre-test and post-test results, the value sheets did not affect students' reactions to a significant number of items on the affective test.

A procedural model for developing environmental education programs for teachers of young children was the research of Brice (1973). Development of the model revolved around design and evaluation of an instructional unit which served as a prototype for testing proposed program development strategies. It was concluded that the prototype satisfied the criteria specified for effective environmental education and that procedures designed for the study offer a viable strategy for developing effective environmental education programs for teachers of young children.

Summary

Studies reported above indicate a variety of dimensions used by practitioners in environmental education:

1) Field trips, media, and classroom/outdoor experience approaches are often useful in helping the student gain conceptual understanding.

2) The classroom setting appears to be better for initial conceptualization, but may not be superior in developing application.

3) Outdoor experiences appear to be useful in promoting concepts and values appropriate to conservation and environmental education.

4) Broad pandisciplinary approaches to environmental education are possible at no or little increase in cost to a school system.

5) Strategies appropriate for teacher-oriented environmental education exist and appear to be effective.

IV. Simulations, Gaming and Modeling

The use of simulations and gaming was the subject of an investigation by Sibley (1974) comparing the effectiveness of a simulation exercise, a simulation game, and conventional instruction, at the elementary and junior high levels, for the teaching of facts and concepts related to ecology and problems of population and pollution. He attempted to determine whether or not attitudes of 163 sixth graders were changed in relation to the environment as a result of participating in four simulation games. Each student who came from one of six homerooms was assigned to a control or experimental group based upon educational ability, achievement, emotional-social growth, self-motivation, and reading level. An Environmental Attitude Inventory (EAI) was administered to each student in the control and experimental groups. Those in the experimental group spent fifty minutes a day on one of four simulation games until each one had been played. Then all students took the EAI post-test. Findings pointed out that the use of simulation games effected favorable attitudinal changes toward the environment among sixth graders. Also, variations on the post-test provided evidence of the fact they were not related to sex, I.Q., reading level, or science achievement.

V. Cognition of and Attitudes Toward Environmental Education Concepts

The review of twelve studies by Roth and Helgeson (1972) of student attitudes and behaviors included four which reported on attitude and behavior toward conservation or pollution topics. The summary of these studies suggested:

1) The ability to identify or recognize environmental problems does not necessarily imply knowledge or understanding of the problem.

2) Statements of behavior with respect to conservation concerns do not satisfactorily predict observed behavior consistent with such statements.

3) While attitudes favorable to environmental concerns are related to past experiences, there is little or no evidence to suggest that formal science education enhances these attitudes more than does education for the non-science major.

4) Some evidence does appear to suggest that positive attitude change is promoted by interest motivation and exposure to conservation education experiences.

Several recent studies have been conducted dealing with belief and attitude shift or change and the performance of a variety of evaluative instruments in relation thereto. These are summarized below.

Eastman (1973) used a semantic differential instrument containing thirteen concepts and a unit on litter pollution to develop and validate an environmental attitude measure. He worked with 1,100 sixth graders in Maryland in a five to fifteen hour instructional unit. There were two types of instruction: teacher-centered and student-centered. One-half of the students were pre-tested before the instruction period. All students were post-tested. No significant advantage of either teaching method was discovered, nor were significant attitude changes identified after treatment (instruction). Eastman suggested both the weakness of the materials and the time element may have affected the results of the research but claims that semantic differential techniques show promise as a method of measuring attitudes with predictive validity, though little evidence is offered.

Leith (1973) developed an elementary environmental attitudes program to be used with student teachers during their practice teaching. Twenty-nine student teachers participated in the program, which lasted three to four weeks. Leith reports some attitude changes by both children and student teachers, based on pre- and post-tests using the Environmental Semantic Differential and the Questionnaire on Environmental Problems for the student teachers and the Environmental Semantic Differential and

the Environmental Concern Inventory for the children. Time was considered an important factor controlling change in attitude, more time being necessary for effective attitude change.

Perkes (1972) conducted a study designed to acquire baseline data about 10th and 12th grade students' environmental knowledge and attitudes and to study the relationship of attitudes and knowledge to variables of interest in evaluative measures. The staff of the ERIC Clearinghouse for Science, Mathematics, and Environmental Education and selected consultants developed three forms of an inventory which contained items requiring knowledge of specific facts and general concepts of the environment. Also, several items elicited students' attitudes about certain aspects of the environment. The inventory was administered to a maximum of 30 tenth grade students and 30 twelfth grade students from each of 199 schools randomly selected from the Great Lakes states of Illinois, Indiana, Michigan, Ohio, and Wisconsin, and the Far West states of Alaska, California, Hawaii, Nevada, Oregon, and Washington.

Perkes found that males scored significantly higher than females on items requiring knowledge of facts, but not on items dealing with general environmental concepts. Twelfth graders scored significantly higher than tenth graders on the environmental concept items, but not on the items requiring knowledge of environmental facts. In regard to attitudes, differences were found based on sex and grade level. However, the calculation of a Chi-square statistic using proportions instead of the total number of cases indicated that proportional differences were slight.

The size of the community where the respondent lived and went to school was not significantly related to knowledge of environmental facts and concepts, but was related to items requesting the respondent to identify what he thought to be the major environmental concern of the community. Using a forced choice technique, Perkes found a positive relationship between the size of community and the selection of pollution as the major community problem. However, this trend was reversed in cities over 100,000 population and concerns seemed to change toward sociological, crime and/or health related topics.

State of residence was also related to what was considered to be the major environmental concern in the community. California respondents selected air pollution; Wisconsin respondents were more concerned with water pollution; respondents from Hawaii considered land-use to be of major importance.

Due to the large student sample used in this study (10,264), few significant relationships should have gone undetected. Also, where no relationships were found, it was indicated that replication should produce similar results. Bohl's (1976) results parallel those of Perkes, utilizing a different array of 22 states, with a variation in data of less than two percent.

Bohl's (1976) study was the second of a three-part national environmental assessment. The purpose of this study was to measure cognitive and affective environmental information among tenth and twelfth grade students. The sample of over 15,000 students was drawn so that

population distribution in each state was accurately reflected. The environmental inventory was administered by classroom teachers in over 270 schools in 22 states of the Mideastern, Southwestern, and Plains and Mountains regions of the United States.

Three separate 40-item inventories were developed involving environmental facts, concepts, principles, beliefs, and perceptions. The responses were tabulated; response frequencies were compared with those resulting from the other two parallel studies. A Chi-square analysis was made on the basis of sex, grade level, size of home and school communities, and state of residence. Correlational and factor analyses were also made on the data.

The results showed that in all cases the response frequencies of this study were within 2% of those from the other two counterparts of this study, confirming nationwide consistency. The 0.001 level was considered statistically significant for the Chi-square analysis, since the sampled population was so large. Sex was found to be a statistically significant factor on about one-half of the inventory items on each form. Grade level was found to be a statistically significant variable on about one-fourth of the inventory items. The size of home and school communities, and the state of residence were found to be statistically significant variables on about one-fourth of the inventory items. Correlation analyses identified three sub-populations: (1) a small number of students possessing a high amount of cognitive information and positive attitudes, (2) a majority of students possessing a low amount of cognitive information and positive attitudes, and (3) a small number of students possessing a low amount of cognitive information and negative attitudes or no opinion responses. Although all three forms of the inventories were composed of basically different questions, all three inventories factored similarly. The most prominent factor identified incorrect cognitive responses with negative or no opinion affective responses.

This study indicated that the average high school student possesses a limited amount of cognitive environmental information. The attitudes possessed by high school students were termed "learned responses" since the correlation between these attitude responses and cognitive information was very low. Therefore, those attitude responses were not considered to be firm beliefs on the part of the student.

A British nationwide survey was organized and conducted by Richmond, a University Fellow at The Ohio State University (1976), with the cooperation of Richard F. Morgan, a lecturer in environmental studies at the Preston Polytechnic School of Education in England.

The purpose of the study was to establish baseline data relating to the environmental knowledge and beliefs of fifth year secondary students in England and to ascertain whether significant relationships exist between:

a) The environmental knowledge of students and selected variables;

b) the environmental attitudes of students and selected variables; and

c) the environmental knowledge level of students and their attitude toward the environment.

The instrument developed for this study consisted of three questionnaires each containing 45 items. While any one student was asked to respond to one questionnaire, the use of three different forms randomly distributed among the sample is a useful technique for eliciting a maximum amount of information. All of the items used in the instrument were thoroughly tested and analyzed in a pilot study involving almost 400 students from nine representative English schools.

The questions were designed to measure the factual knowledge, conceptual understanding, and beliefs that students have relating to areas of environmental concern. The areas of concern were broadly categorized as pollution, population, natural resources, land use, energy, environmental health and safety, ecological relationships, and social, political, and economic influences.

A sample of 500 schools, representing about ten percent of all secondary schools in England, was randomly selected to take part in the survey. Each distinctive type of British secondary school (comprehensive, secondary modern, grammar, direct grant and independent) was proportionately represented. School principals were asked to administer the questionnaires to a heterogeneous group of thirty students in the fifth year (fifteen year olds).

A total of 383 schools (76.6%) returned completed answer sheets providing information from over 11,000 students. The data were then transferred from answer sheets to punched cards and analyzed by standard computer programs. It was found that:

1) Students responded poorly to factual knowledge items;

2) students demonstrated a good understanding of environmental concepts;

3) response patterns indicated that on belief items students had a moderately positive attitude toward the environment.

Prior to this study similar large-scale environmental surveys were conducted in the United States and Australia. In 1972 Perkes and Bohl of The Ohio State University initiated the first national survey of environmental knowledge and attitudes by collecting data from 10th and 12th grade American students as reported earlier in this paper. Three years later Eyers (1972), an Australian working at Oregon State University, used a modified version of the American instrument to conduct a similar survey of 10th grade Australian students. Since many common items were used in the questionnaires administered in the United States, Australia, and England, it will be possible to compare the relative environmental knowledge and attitudes of students from these countries. As other countries are surveyed, more extensive cross-cultural comparisons will be possible. Such comparisons would be helpful in providing insight into the "exportability" of existing environmental education curricula.

The results described in Richmond's study are strikingly similar to the response patterns observed by Bohl, Perkes, and Eyers. In their studies, students at the equivalent grade level were reported to have a generally poor grasp of factual knowledge (with higher levels of conceptual knowledge evident in the United States), and yet they tended to express positive environmental attitudes on the affective questions. Students did not perceive local environmental problems, but were prepared to attribute such problems to the national scene. So critical problems like overcrowding were considered more serious than problems relating to the physical environment. Significantly students identified "reading, radio, and TV" as the major sources of environmental knowledge. Those indicating "school courses" as their source of information scored significantly lower on factual, conceptual and belief items.

In addition, the data generated by these studies, and hopefully by similar surveys in a number of other countries, might well provide the basis for developing models for international environmental education in accord with UNESCO recommendations.

Horvat (1974) used semantic differential and Likert agree-disagree formats in instruments to determine environmental orientations of fifth and eighth grade students. Three instruments, found valid by content and panel ratings, reliable by Hoyt internal consistency and stable by test-retest correlation coefficients, were tested on 665 students. Eighth graders were found to be more consistent and stable in their environmental orientations than fifth graders. Analysis of variance helped identify differences in environmental orientation among students grouped by grade, community type, sex, I.Q. and socioeconomic status. Eighth graders were found to be less optimistic toward the future than fifth graders. Suburban and urban children were less optimistic about the present world than were rural children. High I.Q. and grade level criteria most often showed significant relationship to environmental orientation. The students agreed on air pollution as the most serious environmental problem. Wilderness preservation and population control were concerns for high socioeconomic status children, while noise and water pollution were of greater concern to low socioeconomic children.

Parker (1974) used a semantic differential technique to analyze the environmental attitudes of 180 students in grades 4, 6, 8, 10, and 12. Subjects responded to projected color slides which served as concept stimuli. Differences in environmental attitudes were sought on the bases of grade level, sex, area of residence and level of intelligence. The data collected were factor-analyzed and analysis of variance was carried out on component scores of the cell means for each extracted factor. Statistically significant pair-wise differences of the main and interaction effects were tested for, using Tukey's method. Nineteen factors emerged from the seven test concepts with a mean common factor variance of 50% per concept. Grade level differences were significant for fourteen factors; eleven of these also showed significant interaction with areas of residence. Attitudes toward pollution problems showed an upward trend from grades four to ten but decreased in strength in grade twelve. A

change in attitudes toward aesthetic aspects of the environment occurred from grade four to grade twelve. No consistent attitude patterns were evidenced other than for grade level.

Zacher (1974) reported a study of 436 eleventh grade Montana students' responses to the Syracuse Environmental Awareness Test, a cognitive measure of environmental knowledge. Variables selected for analysis included sex, hobbies and activities, variety of reading material, television viewing, father's occupation, family size, participation in a formal environmental program, and geographic location. These were obtained through the use of a student data sheet. Mean scores achieved on the test were used to determine significant differences by t-tests for the independent student variables. Males scored higher than females, students from smaller families scored higher than those from large families, regular readers of three or more periodicals higher than those reading two or less, and non-participants in a formal environmental program higher than participants. The Montana students scored higher than did the norming population (Middle Atlantic and New England states) on the test. All these differences were reported as significant.

Noeske (1974) studied the attitudes of fifth graders in Milwaukee toward the urban environment of today and the future. The study was divided between real (field trip) and simulated (slide/tape presentation) instruction of students living in three geographic areas: center city, mid-city and suburbs. Semantic differential instruments were used to sample attitudes and analysis of variance and t-tests (.05 level) were used to determine the significance of the data. No significance was attributed to the data collected about the city, while field trips were found to be of significance in dealing with the city of the future. Center city students had a more positive attitude toward the city of the future. The grand mean score of attitudes toward today's city and the grand mean score of attitudes toward the future's city showed a significant difference for all the students.

S. Vogl (1973) developed two formats for a course of study on the Great Lakes water resources, lecture and individual inquiry, to determine which approach developed the more positive attitudes toward the Great Lakes in a class of inservice teachers.

Concepts for teaching were determined by a jury panel of experts. A Likert-type paper and pencil test was used as a pre-test and post-test. Analysis of data by various statistical approaches revealed that the mean post-test score for the lecture group was significantly higher than that of the individual inquiry group. No relationships were found to exist between test scores and age, sex, marital status, grade or subject taught, number of credits previously earned in biology, geology, sociology or other environmental courses. Most subjects felt that a combination of lecture and individual work would be beneficial.

The above noted studies demonstrate that a number of investigations have examined the attitudes of students toward the environment and its problems. These varied approaches have produced a variety of outcomes. In some instances differences have been demonstrated among students according to sex, residential location, age and socioeconomic status, but

in other instances no significance has been observed. The majority of the studies mentioned have dealt with the cognitive and attitudinal characteristics of public school children. Only one, Horvat, mentioned environmental orientation.

Summary

It can be observed that:

1) Positive attitude changes occurred in several studies as the result of specified treatments.

2) A positive relationship appears to exist between knowledge of and attitude toward environmental issues, as noted in studies reported above.

3) Differences in knowledge levels have been noted to relate to urban/suburban and regional experiences and perceptions, grade level, and sex of the student.

4) Positive relationships have been noted between outdoor or field experiences and cognitive achievement.

Perkes suggested that the youth of the United States have positive attitudes toward environmental management, but have little idea as to how or where things can be changed to achieve a satisfying quality environment.

It should be remembered, as suggested previously, that stated behavior toward the environment is not necessarily a predictor of observable action.

VI. Evaluation Instruments for Environmental Education

Seventeen dissertations, 1972-1975, dealing with instrumentation showed evidence of statistical analysis of data drawn from environmental education and environmental science programs. Three surveys of evaluation instruments done by Perkes (1973), Wheatley (1974), and Doran (1974) were reviewed, as were other works by Bennett (1974), Hounshell and Liggett (1973), and Howie (1974). The test instruments were either pencil and paper instruments or combination instruments. Bennett (1972) describes three types of evaluation techniques useful for environmental education programs: (1) pencil and paper instruments which are used by the majority of the researchers [a disadvantage of this technique is the awareness by the subject of the testing process]; (2) the "unobtrusive measure" which consists of contrived and simple observations of behavior during which the subject is unaware that he is being evaluated; and (3) direct observation of subjects involved in the learning process. No evidence was found of either the unobtrusive or the observation techniques being used, except in a few combination instruments.

Evaluation instruments are listed by author and title, for ease of identification.

Pencil and Paper Evaluation Instruments in Environmental Education

Asche (1972) -- Environmental Attitude Scale

A pre-test and post-test evaluation instrument developed by Asche was designed to measure student attitudes concerning environmental concepts relevant to desirable environmental attitudes. The population consisted of all the secondary classes within a selected school. These classes were randomly ordered and randomly assigned to treatment groups for a pre-test and post-test control group design. The sample tested consisted of 306 students.

The internal consistency of the scale was calculated using the Kuder-Richardson formula obtaining a correlation coefficient of 0.66, and a split-half method which resulted in a correlation coefficient of 0.67. The data were analyzed by item analysis of frequency distributions on students responding to each test item according to key weight answer positions, and one-way analysis of variance. The item analysis resulted in twenty test items significant at the 0.05 level of probability. There was no significant difference between the vocational experimental group and the vocational control group when gain scores were tested by analysis of variance. The gain scores between the vocational and the non-vocational control groups were tested and statistically significant differences were found.

Bowman (1974) -- Opinions About Environmental Issues

The evaluation instrument was a pre-test and post-test instrument that assessed attitudes toward environmental decision-making. It was field tested on a population of 331 college students.

Data were analyzed for reliability and by analysis of variance. Student attitudes toward determinates of environmental issues did change significantly as a result of an introductory environmental management course. There was no difference between the lecture discussion methodology and the simulation study methodology utilized. The author postulated that the broad nature of environmental education may place certain restrictions on the number of attitudes it is feasible to assess on any one instrument, and recommended a study to discriminate the various levels of commitment to act as a result of the intensity of the respondent's attitude toward environmental issues.

Ciesla (1974) -- Ciesla Instrument

This was a pre-test and post-test instrument used to evaluate the effectiveness of a self-instructional environmental study learning guide on students obtaining a measurable cognitive gain in the understanding of environmental concepts. Students enrolled in a university introductory natural resources course and students enrolled in an elementary methods class served as the experimental and control groups. The data were analyzed using the t-test. The results indicated that an effective self-instructional learning guide to an outdoor education area could be developed and utilized by university students. When utilized in such a way a measurable cognitive gain in the understanding of environmental concepts resulted.

DeBlanc (1973) -- The Metropolitan Achievement Tests: Science Concepts and Understanding and Science Information

The instrument used was a pre-test and post-test science achievement test. The study evaluated the science academic mean performance difference between senior high school pupils who took part in an outdoor education experience and those senior high school pupils who did not take part. A group of 285 senior high school science pupils were considered as the experimental group. Another group of 194 senior high school science pupils from a different school were used as the control group. Both groups were pre-tested and post-tested with the same instrument.

The statistical treatment was an analysis of variance on the gathered data. F-ratios in terms of the five hypotheses of the study were obtained and checked for significance at the 0.05 level of confidence. Senior high school science pupils having outdoor education experiences as part of a science program appeared to achieve significant gains over science pupils not exposed to the program.

DeLucia and Parker (1974) -- Modified Semantic Differential Instrument for Determination of Changes in Environmental Attitudes

This test instrument was a set of color slides used to measure student environmental attitudes. The test population consisted of students from grades 4, 8, and 12. The evaluation instrument was analyzed for reliability, means, and related information. Data were analyzed by analysis of variance and the factor analytic technique. The authors concluded that the instrument is a valid and reliable evaluation instrument of environmental attitude although generalizable aspects are not indicated.

Hamann (1973) -- Hamann Environmental Values and Attitudes Test

This pre-test and post-test instrument was used to evaluate a value-oriented environmental education program. The program included the validation of the usefulness of the investigator's environmental education guide, an inservice teacher training program in human values education. A comparison school and experimental schools I and II were used to measure whether there was a significant difference in student values and attitudes toward the environment as a result of being exposed to a value-oriented concept and strategic framework. The subjects were all the (285) sixth graders and nine teachers from three schools which were comparable in socioeconomic level.

Utilizing a factorial design with unequal, within-cell, sample sizes, the data were subjected to analysis of variance. From the analysis of the data it was determined that the students in the comparison schools whose teachers received no manual or inservice training experienced significant losses in both value status and in attitude toward the environment. The students in experimental school I, whose teachers received the manual only, showed significant losses in both value status and in attitude toward the environment. The students in experimental school II, whose teachers received both the manual and the inservice training, recorded significant positive gains in both the value status and attitude toward the environment. It was concluded that without inservice training, no effect in the values and attitude changes occurred.

Hosley (1974) -- Hosley Retention Test

This test was used to evaluate two methods of instruction in environmental education. One method used outdoor field studies and the other used a slide tape (AMI) presentation of the same concept. From a total population of 400 fifth-grade students, 100 subjects were selected at random and assigned to four treatment groups of 25 each. Group I served as a control and there were three experimental groups.

The data were subjected to analysis of variance between and within treatment groups, plus a postmortem comparison between means using the Duncan Multiple Range Test. Students who received instruction through AMI scored as high as students instructed by field methods. Students who received instruction through AMI scored higher than students who received no instruction. Students who received instruction through AMI did not

score as high as students who received the combination of AMI plus field experience.

Hounshell and Liggett (1973) -- Environmental Knowledge and Opinion Survey (EKOS)

This test instrument was designed to evaluate students' knowledge about and attitudes toward the environment. Sixth-grade students (1,881) were randomly selected from nine school systems for the test population.

An analysis of data to determine significant differences was computed, using t-tests between subgroups of male and female students and rural and urban students. The minimum acceptable level of significance was 0.05. In comparing all urban students in the sample, there was no significant difference found on the attitude subtest. There was a significant difference between the scores of urban students and those of rural students on knowledge. In comparing all participants' scores on the attitude subtest with scores on the knowledge subtest, a correlation coefficient of 0.6 was found. There was a high correlation between the individual's knowledge about the environment and his positive attitude toward the environment as measured by EKOS. There was no significant difference in attitudes toward the environment between urban and rural students, but there was a significant difference on the knowledge subtest. The author postulates that one viable approach to creating constructive environmental attitudes appears to be through providing knowledge about man's environment; therefore, a well-structured, well-planned approach to environmental education will yield positive attitudinal changes.

Howie (1974) -- Environmental Resources Concepts and Application Survey

The evaluation instrument was a post-test developed by the author. The instrument was used to determine the effect of an outdoor environmental education program as compared to one conducted completely indoors. These two types of programs were then combined into an indoor-outdoor program and compared. The test population was fifth-grade students randomly assigned by classroom to four experimental conditions.

The reliability of the evaluation instrument had a correlation coefficient of 0.92. In all cases students who received one of the new environmental treatments scored significantly higher than the control group that received no treatment. The t-test was used to analyze the data. Analyses showed that the advanced organized classroom program was superior to the oudoor discovery type of learning when compared on a cognitive scale. There was no significant difference when classroom treatment was compared to the combination outdoor-indoor treatment. There was a significant difference between these treatments and no treatments. The authors recommend that environmental education programs should be an extension of the classroom, not a unique experience. If conceptualization is desired, students need extensive and structured programs of advanced organization.

Kleinke and Gardner (1972) -- Syracuse Environmental Awareness Tests (SEAT)

This four-form evaluation instrument was developed by Gardner, Kleinke, and Coner to measure the cognitive and attitudinal realm among high school students and adults. Norms for the SEAT were determined by raw scores obtained from a sample of over 1,250 eleventh graders from the Middle Atlantic and New England states.

The KR-20 reliability coefficients of the total test scores range from 0.83 to 0.95. From total test percentile ranks and Stanine norms, the mean was calculated to be 29.5, with S.D. 8.3, for 56 test items.

Oetting (1973) -- Paragraph Completion Test

This instrument was developed by David Hunt and his associates. The conceptual level of all participants was determined by scoring the subject's response to the Paragraph Completion Test. A simple cross-stratified random selection of student subjects was drawn from the 120 students who completed the Paragraph Completion Test. The purpose of the study was to find the relationship between the conceptual level scores of the student participants and the ratings of their performance on the more environmentally complex learning tasks of the Nebraska University Secondary Teacher Education Program (NUSTEP).

Pearson product-moment correlation coefficients were calculated to determine the nature of the relationship between the variables being considered in the general and auxiliary hypotheses. A significant positive relationship at the 0.01 level of confidence was found between the conceptual level of the subjects and the ratings of their performance on the more environmentally complex learning tasks of NUSTEP. The final conclusion was that a negative relationship exists between the conceptual level scores of the instructional staff and their ratings of high conceptual level student performance.

Perkes (1973) -- Environmental Knowledge and Attitude Inventory

This was an extensive attitudinal survey done by the Center for Science and Mathematics Education at The Ohio State University. Environmental knowledge and attitudes from a sample of tenth- and twelfth-grade students from all 50 states and the District of Columbia were obtained. The instrument has three forms containing multiple choice items which deal with facts, concepts, and attitudes. Individual schools were randomly selected and students randomly selected within the schools. The instrument was tested for reliability using the KR-20 which resulted in reliability coefficients from 0.79 to 0.92. Chi-square statistics based on proportions were used instead of the total number of cases used. Items asking students to indicate what they thought was the most pressing environmental problem correlated highly with the state and community size.

Kellner (1971) -- Environmental Concern Inventories (ECI) -- Project I-C-E

Project I-C-E (Instruction-Curriculum-Environment) is an environmental education program of the Wisconsin Department of Public Instruction. This attitudinal assessment instrument has three versions according to grade level: K-4, 5-8, and 9-12. The design of the instrument is oriented toward environmental problems and is best used in evaluating student needs and growth in environmental management. The original test population consisted of over 9,000 students. Statistical analysis of the data revealed positive gains in knowledge in relation to program objectives.

Rentsch (1973) -- Rentsch Instrument

This is an instrument to measure the understanding level of ten environmental concept categories as well as the possession level of a knowledge of facts, organizations, and universals and abstractions. The test population was 80 female seniors, pre-service elementary teachers and education students.

The instrument was evaluated as follows: (1) Kuder-Richardson Reliability Index of 0.79; (2) Item Johnson Discrimination Index of 0.31; (3) Standard Deviation of 6.15; and (4) Standard Error of 2.81.

The implications of this study for a school using the test instrument are that the school must evaluate its obligation and responsibility to produce an environmentally literate citizenry. The school must clarify the existing institutional arrangements whereby deficits in the understanding level of the ten environmental concept categories, knowledge components by its students and/or faculty can be corrected.

Riblet (1971) -- Environmental Awareness Scale and Environmental Opinion Scale

Two instruments were designed to measure college students' knowledge of environmental problem areas and to assess subsets of environmental opinions. Factor analysis was used to confirm fact validity and reliability of test items. The subsequently retained items were suggested to be useful in the development of profiles of student knowledge and opinions about environmental issues as a guide to the development of individualized instruction and improved group instruction.

Sibley (1974) -- Environmental Attitude Inventory (EAI)

The evaluation instrument was a pre-test and post-test technique to measure environmental attitudes. The study involved 163 sixth graders who were all administered the EAI pre-test. All of the sixth graders came from six comparable homerooms and were assigned to either a control group or an experimental group. The purpose of the study was to determine whether attutudes of sixth graders changed favorably or unfavorably toward the environment after participating in simulation games.

Seven null hypotheses were tested for significance at the 0.05 alpha level. Four of these were examined by analysis of variance and the other three by the Pearson correlation analysis. There was a significant difference between the mean scores of the experimental and control groups as measured by the post-test of the EAI. Statistical inferences indicated inconclusive evidence that the simulation games affected favorable attitude changes among sixth graders toward the environment, as measured by the EAI.

There was a significant difference between mean scores of the experimental and control groups as measured by the post-test, no such difference between the experimental groups participating in debriefing sessions and those not participating, and no differences between the responses of males and females. Variations in environmental attitudes on the post-test EAI were not related to I.Q., sex, or science achievement level in those students participating in the simulation exercise.

VanMeter (1972) -- Semantic Differential Technique

This evaluation instrument was used to assess attitudinal changes in sixth grade students after a five-day outdoor education experience. It consisted of 10 concepts; students rated each on a series of 15 semantic differential pairs. VanMeter found significant differences at the 0.05 level between pre-test and post-test responses in two out of four groups of students who participated in the camping experience. He concluded that ROE programs do not always result in positive attitudinal changes for all students.

Watkins (1974) -- Water Concern Scale

This evaluation instrument contains five factors testing the knowledge of and attitude toward water resource problems. The instrument was developed by the author using ten Likert-type items related to attitudes about water resources which were administered to over 300 residents of two Florida cities. Data were analyzed via factor analysis and Guttman's Scalogram Analysis.

Five factors were obtained by the author and labeled: Willingness, Awareness, Knowledgeability, Rationality, and Economic Commodity. The five items that satisfied the Guttman Scale criteria were labeled "water concern scale." It is suggested that this technique will be useful in aiding the respondent to operationalize personal behavior in relation to an environmental issue.

Wright (1971) -- Semantic Differential Attitude Instrument

This semantic differential attitude measuring instrument was developed as an immediate test-retest instrument to measure the effect of a television-oriented inservice program on the elementary teacher's attitude toward some components of environmental education. A pilot instrument was run on 70 elementary teachers. A Pearson product-moment correlation of .80

TABLE I

Pencil and Paper Evaluation Instruments in Environmental Education

Instruments	Areas Measured								
	Attitudes	Cognitive	Curriculum Materials	Value Clarification	Inservice Teacher Programs	Methods of Interview	Concepts	Simulation Games
Environmental Attitude Scale	*							
Opinions About Environmental Instruments	*							
Ciesla Instrument		*	*					
Metropolitan Achievement Test		*						
Modified Semantic Differential	*							
Environmental Values and Test	*		*	*	*			
Hosley Retention Test						*		
EKOS	*	*						
Environmental Resources Concepts and Application Survey						*		
SEAT	*	*						
Paragraph Completion Test							*	
Environmental Knowledge and Attitude Inventory	*	*						
ECI	*							
Rentsch Instrument		*					*	
Environmental Awareness Scale and Environmental Opinion Scale	*	*						
EAI	*							*
Semantic Differential	*							
Water Concern Scale	*	*						
Semantic Differential Attitude Instrument	*	*						

was obtained from that group for the total instrument. The experiment was conducted on 90 elementary teachers divided into two equal groups.

The semantic differential was analyzed through analysis of covariance. In every case, the pre-treatment semantic differential score was the control variable. It was concluded that a television-oriented inservice program on environment promoted elementary teacher attitude change toward the total of all environmental education study components. The change was in the direction of a more favorable attitude toward the total of all study components.

Combination Instruments

Bennett (1973) -- Evaluation Model

Bennett's instrument consisted of three evaluation techniques comprising a model for environmental education evaluations. The first was a pre-test set of slides. The second was an unobtrusive measure, or an optional take-home questionnaire. The third was a direct observation on a school site survey trip. Unit behavioral objectives for a two-week unit focusing on the environment of the school site were evaluated with the test population being comprised of 75 randomly selected sixth to eighth grade students. Data from the pre-test and post-test technique were analyzed using t-tests. A lack of overall affective achievement was attributed to effects of the pre-test and post-test question design, a change of subject enthusiasm, and subject selection bias. This may be due to the effect of a two-week unit of instruction, the small sample, and the inadequacy of the test instrument.

It was concluded that the model evaluation strategy developed can provide a basis for developing evaluation instruments and techniques.

Brady (1972) -- Brady Instrument

The effectiveness of field trips compared to media in teaching selected environmental concepts was evaluated using a combination technique. A test population of nearly 100 students was randomly assigned to either the experimental or control group. Two areas were evaluated: student achievement and attitude.

Four variables--pre-test scores, I.Q., Grade Point Average, and background in science--were used as covariants. The data were analyzed using t-tests, analysis of variance, and analysis of covariance. A highly significant difference was found beyond the 0.01 level between pre-test and post-test scores for both treatment groups. The author concluded that both field trips and media can be used as successful teaching methods in presenting selected environmental concepts. The use of field trips and media both resulted in a significant positive change in attitude toward current environmental problems.

Carlson (1972) -- Guess Who Inventory, The Selected Outdoor Pictures, The Concept Factor Scale

These three evaluation techniques were used to evaluate the extent to which a resident outdoor education experience influenced intermediate-level children's perceptions of peers and of the out-of-doors. The Guess Who Inventory and The Selected Pictures were developed by the investigator. A pre-test and post-test non-equivalent control design was used for the test population of 64 intermediate level children from three intact home-rooms. The derived scores from the three testing instruments were analyzed with a one-way analysis of variance. No significant differences were found between the experimental and control groups in the number of shifts in peer nominations from pre- to post-test on the Guess Who Inventory. No significant differences were found between the experimental and control groups in the number of word concepts elicited from pre- to post-test in response to The Selected Outdoor Pictures. The author concluded that resident outdoor education experience did not influence intermediate level children's perceptions of peers or of the out-of-doors as assessed by these techniques.

Fleetwood (1972) -- Environmental Science Test, Environmental Attitude Inventory

This combination technique was used to measure the extent to which high school students had achieved specific objectives of environmental education. A separate instrument was designed for the cognitive and the affective domains. Using standard test development procedures, items for the Environmental Science Test and the Environmental Attitude Inventory were developed and subjected to item analysis. The final versions were computed to have an internal reliability of 0.93 for the Test and 0.90 for the Inventory as assessed by the KR-20. The test populations for the Test and the Inventory were 1,649 and 1,633 high school biology students, respectively. The standard error of measurement was less than 4.0 points for each instrument. The author concluded that these two instruments were both reliable and valid.

Jeffers (1974) -- Fortune/Hutchinson Methodology

This technique is a set of general system models for determining goals, operationalization and implementation of the Measurement Process for Observational Technique. Data were collected by two trained observers using the Modified Obtrusive on children who were aware of visitors but not evaluation, and the Unobtrusive where observations were done through an observation tower. Results indicated that the reliability and validity of the Modified Obtrusive were higher than the Unobtrusive condition. The investigator concluded that the Fortune/Hutchinson Methodology will continue to be successful in producing data geared to a decision-maker's needs and goals in innovative environments, but revisions are needed.

McNamara (1971) -- McNamara Indoor-Outdoor Preference Appraisal; ESCP Achievement Test; Cornell Critical Thinking Test; Concept Test

These four evaluation techniques were used to measure the effects of a group experiencing laboratory investigations in the indoor environment versus outdoor environment. The groups were pre-tested with the ESCP Achievement Test, the Cornell Critical Thinking Test, and the McNamara Indoor-Outdoor Preference Appraisal. There was a minimum of two groups per I.Q. level and one-half of the group in each level was randomly assigned to the outdoor environment.

On the basis of an analysis of variance of mean gain scores, percentage mean gain scores, and an analysis of variance of post-test only scores, the following conclusions were reached: learning in the outdoors is enhanced if the concepts are directly related to the environment, and critical thinking and preference for the out-of-doors are changed favorably as a result of the out-of-doors treatment.

Sheldon (1973) -- Environmental Management Concepts List; Tennessee Self-Concept Scale; Inventory of Social Issues; Test on Understanding Science

The combination of these evaluation instruments was used to measure how effective a summer environmental education program was in fulfilling its objectives. The research design was a "before-after" with control groups. The experimental groups consisted of 24 students in a special summer program, Environmental Action Program (EAP), at the University of Iowa. The students were stratified into two equal groups based on socioeconomic background. The control groups consisted of students from a field ecology program and a biology program.

An analysis of covariance was used to analyze the variables. The t-test was used on comparisons between socioeconomic groups. The analysis indicated:

1) Participation in the EAP program resulted in an increase in the ability of the student to assess environmental management concepts as measured by the Environmental Management Concepts Lists.

2) Participation in the EAP program resulted in positive growth for some level and dimensions of the self-concept of students as measured by the Tennessee Self-Concept Scale.

3) Participation in the EAP program resulted in some change of attitudes of students relating to social issues measured by the Inventory of Social Issues.

4) Participation in the EAP program did not result in a change of student understanding of science as measured by the Test of Understanding Science.

The growth in a number of areas was greatest for students with high socioeconomic backgrounds.

Ulrey (1974) -- Nowicki and Strickland Locus of Control Scale (NSLCS); Intellectual Achievement Responsibility Questionnaire (IARQ)

The effects of an outdoor education program designed to improve children's physical competencies and problem-solving skills were measured by this combination of instruments. The test population was predominantly white, middle-class, pre-adolescents who attended a summer camp program. A total of 140 subjects were randomly assigned to experimental and control groups, stratified by age. Both age groups were tested separately, pre- and post-treatment, using the written instruments. NSLCS measured general Locus of Control (LC) beliefs. The IARQ measured academic LC beliefs. An observation rating scale was also used.

The results of the analysis of the data indicated moderately low construct validation for LC construct as measured by the NSLCS and the IARQ, with a reliability coefficient of 0.63 - 0.68 as measured by the KR-20. Analysis of covariance was conducted for pre- and post-LC scores. It was concluded that the outdoor education program modified the LC orientation of the children tested.

Summary

The following is a summary of the conclusions found in the studies reported in this chapter:

1) Inservice training for teachers is of value if measurable effects in values and attitude changes of students are desired.

2) Senior high science students were observed to make significant gains in the cognitive domain after outdoor education experiences.

3) There is a need for structured programs and advanced organization in order for conceptualization to occur in an outdoor education experience.

4) Combinations of media and outdoor education experiences may result in significant gains in the cognitive domain.

5) "Proper knowledge" may be correlated with positive attitudinal changes.

6) There is a limit on the number of attitudes that can be assessed by any one instrument.

7) Resident outdoor education programs do not always result in positive attitudinal changes for all students.

TABLE II

Combination Evaluation Instruments in Environmental Education

Instrument	Areas Measured									
	Objectives	Concepts	Methods of Instruction	Perceptions	Cognitive	Affective	Self-Concept	Physical Competencies	Problem-Solving Skills	ROF
Evaluation Model	*									
Brady Instrument		*	*							
Guess Who Inventory				*						*
Selected Outdoor Pictures				*						*
Concept Factor Scale		*								*
Environmental Science Test	*				*					
Environmental Attitude Inventory	*					*				
Fortune/Hutchinson	*									
McNamara Indoor-Outdoor Preference Appraisal			*			*				
ESCP Achievement Test			*		*					
Cornell Critical Thinking Test			*							
Concepts Test		*	*							
Environmental Management Concepts List	*	*								
Tennessee Self-Concept Scale	*						*			
Inventory of Social Issues	*					*				
Test on Understanding Science	*				*					
NSLCS								*		
IARQ									*	

8) Learning in the out-of-doors may be enhanced by concepts directly related to the environment.

9) Critical thinking and preference for the out-of-doors may be changed favorably as a result of an outdoor experience.

Due to low reliability and low validity of many of the instruments included in this review, most of these conclusions are not generalizable.

VII. Investigations of Teachers' Attitudes Toward Environmental Education Concepts

Four studies related to teachers' attitudes toward the environment or toward environmental education concepts were found. Lyons (1971) investigated the attitudes of prospective teachers relevant to environmental problems. Only three subjects participated in the six group planning sessions in which lessons were developed to teach environmental education in the participants' elementary school classes. The lessons were taped upon presentation in the subjects' classrooms. The tapes assisted Lyons in identifying changes in the subjects' attitudes toward environmental problems, as did pre- and post-tests with an attitudinal instrument using semantic differential and Likert formats. The researcher reported positive attitudinal changes in the subjects.

Little (1972) discovered the potential of role conflict between environmental aides and classroom teachers when he surveyed training programs for auxiliary school personnel in New England. The survey identified a segment of the female population of suburban towns with an interest in the environment and a willingness to work informally with the schools. These women saw themselves as environmental specialists supplementing the teacher, while the teacher looked for help of a supportive nature in the tradition of a teacher aide. All participants were willing to discuss ways to improve the situation existing at the time of the study.

Johnston (1973) examined opinions and general attitudes among science, non-science and elementary teachers in Mississippi regarding environmental education. Teachers agreed that environmental education should be a part of the curriculum in light of the environmental crisis. Pollution control was identified as a main area of concern and one that teachers can influence in their contact with children. All teachers felt that class discussion was the best method for teaching environmental education concepts, but they also strongly recommended problem solving and community on-site techniques.

Pettus (1975) surveyed 1,100 school teachers on their attitudes toward environmental issues. He found that differences in teachers' attitudes can be effectively measured by analyzing teacher responses to opinion statements concerning the environment. The investigator further suggested that analysis of the responses of different teacher groups might provide insight into the implementation strategies of environmental education programs for students and teachers.

Summary

The limited array of studies found indicates that additional investigation of teacher attitudes toward environmental education would be worthwhile, with the studies cited serving as models.

VIII. Teacher Education

Teacher education is an essential part of every environmental education program. Usually an inservice workshop is held prior to or concurrently with the commencement of the program. Stapp (1963) in an evaluative study of environmental education programs, K-12, placed the establishment of a comprehensive, in-service program among the ten priority phases for development of effective teacher education strategies.

Theis (1974) described a strongly student-centered program, utilizing competency-based instruction, developed to prepare students to teach environmental education. Students determine their own academic needs and plan a self-paced program to meet those needs. During this first phase, extensive use is made of audio-visual supported modules. Then students are involved in working with their own individual projects and sharing the results at weekly meetings in the second phase. In addition, each student participates in a summer National Environmental Encounter Workshop, at which time he travels from coast to coast, analyzing and contrasting natural and human environments. After returning, students conduct workshops and seminars with public school teachers, students, and the community, based upon their trip experiences.

Twelve recommendations for use by the University of North Carolina were described and included field experiences and practice in developing environmental education course offerings for teachers that utilize inquiry methods with hands-on student centered activities. Development of modern comprehensive facilities, internships for leadership in planning, supervision, and communication were recommended. Cash (1973) found similar recommendations coming from participating inservice teachers in his study of science teacher preparation.

Other studies of teacher preparation include one by Brice (1973) in which he developed a model for teaching environmental education to young children. Holt (1973) identified 115 competencies necessary for a classroom teacher in outdoor education, ranging from subject matter competencies to camping techniques.

Pettus (1975) measured teacher attitudes toward environmental education. His attitude inventory was effective enough to have some influence on curriculum change. Sonia Vogl (1973) conducted a similar study, but she included a treatment of inservice programs to effect change in teacher attitudes toward the Great Lakes Region. Robert Vogl (1973) studied superintendent attitudes in how they assessed roles of high school seniors in seeking environmental reforms. Results depended upon relations between school and communities. A study by Rentsch (1973) developed an instrument to measure understanding of environmental problems. The results defined the role the school must fulfill to produce an environmentally literate citizenry in terms of the ten environmental concept categories used in this study.

Akenson (1970) developed a way to incorporate environmental education in classrooms through teacher education. The approach suggested was to train teachers to use literature in the humanities as focal points around which environmental issues can be discussed and analyzed. The emphasis within the proposal was on the analysis of values as they relate to the handling of the various aspects of the environment.

Lunneborg and Lunneborg (1971) evaluated teachers who participated in an environmental education inservice workshop. The teachers were tested with an environmental awareness survey before and after the workshop. These surveys did not indicate a greater final knowledge of environment in the experimental teaching group. Changes in values occurred with significant shifts in the experimental teaching group toward idealism and humanism and away from both scientific and economic orientations toward life. Included in the report are evaluations of environmental learning packages which the teachers had developed.

Summary

Research has been done in this field, but little data exist from which strong inferences can be drawn. The development of model programs, guidelines, and attitude assessment comprised most of the effort in the teacher education area. The mixed results obtained by the studies cited indicate a need for more rigorous evaluation and analysis techniques.

IX. Camp Programs

Since 1972, several researchers have developed study projects for the purposes of evaluating existing camp programs and suggesting possible student reaction to these programs. Research has been done concerning both the traditional resident camp and outdoor education camping programs run by various education institutions.

Keown (1974) evaluated a session of an environmental studies school (the Blue Mountain Environmental School) in the Four Corners region of Utah, Colorado, New Mexico and Arizona. The 14-day camp included three extensive field trips. Data were collected through a multiple-choice test, taped interviews and a questionnaire sent to the parents of the participants. The results showed that: (1) more of the program should be student-planned, (2) emphasis should be placed on enumerating the causes of the environmental crisis, and (3) the teaching should emphasize both personal and group action to solve environmental problems.

Carlson and Baumgartner (1974) tested the effectiveness of a week-long natural resources camp in changing attitudes toward natural resources management. Pre- and post-tests were used to discover: (1) the students' combinations suggested for multiple use plans, (2) semantic differentials (e.g., useful-useless) concerning attitudes about multiple use and natural resources, and (3) the socioeconomic background of the students. In general, student attitudes became more favorable toward the use and management of natural resources.

Sheldon (1973) evaluated a summer program, Environmental Action Program (EAP), taught by the University of Iowa, using field ecology and biology classes as the control group. Besides the pre- and post-test and student questionnaires, four other instruments were used: (1) Environmental Management Concept List, (2) Tennessee Self-Concept Scale, (3) Inventory on Social Issues, and (4) Test on Understanding Science. Sheldon found an increase in ability to assess environmental management concepts and a positive growth for some levels and dimensions of self-concept. It was discovered that in both the areas of assessing environmental management concepts and self-concept, the program was more effective in meeting the program objectives for students of high socio-economic backgrounds. Also, some change of attitude relative to social issues was noted. However, the EAP course did not result in a change of student understanding of science.

Fletcher (1973) evaluated a five-day resident outdoor education program conducted by the Toledo (Ohio) Public Schools. Both advantaged and disadvantaged students at the camp became more self-reliant and self-confident. There was moderate improvement in ability to cooperate with others and moderate transfer of positive goals back to the classroom. Fletcher felt the positive social value of the experience was supported by the fact that the majority of the students liked camp, wanted to stay longer, wanted to return to camp again and felt they made new friends.

Millward (1973) analyzed the research results of West Jefferson Hills School District's outdoor resident camp program. Millward discussed the use of the attitude inventory used and recommendations for future programs with results emphasizing information about developing camp objectives, evaluation instruments, and program activities appropriate for the outdoor resident camp program.

Thies (1974), through participation in program activities, administration, and interviews with leaders and staff members, evaluated operations and innovations at camps in 16 western states. His findings resulted in four recommendations for camp programs: (1) integrate environmental education and field experience into course offerings for teachers, (2) revise curricula and methodology in camp programs, (3) use interdisciplinary curricula, and (4) develop better internship programs.

Summary

Studies pertaining to program evaluation, attitude assessment, and knowledge gain are being conducted in selected areas. A good array of approaches appears to be in use. Application of available technique and research methodology to many camp programs does not appear to be common practice.

X. Administration Guidelines—Practices

Only two studies were identified in the field of environmental education administration.

Hildebrand (1972) researched the problem of state leadership in environmental education. To do this, answers were sought to the following questions: (1) what leadership roles can be recommended for state education agencies (SEA) to facilitate environmental education?; (2) what are some organizational strategies for the exercise of the SEA leadership in environmental education? Title III project directors were surveyed and it was found that: (1) efforts must be made by the SEA to ascertain the needs of environmental education; (2) services must be reconstructed to meet these needs; (3) the SEA must improve its ability to evaluate; (4) cooperative arrangements between agencies are necessary to maximize the use of human resources; and (5) the SEA must reach top administrators in the educational system.

Ulrich (1974) conducted a study to ascertain to what degree selected populations agree on the value of environmental education objectives, and the utilization of these objectives in the public school system. Several other related subjects were also researched. A questionnaire was developed and sent to school officials, teachers, and selected students. Results showed that the State Advisory Committee for Environmental Education should review and revise its objectives, help hold more workshops, develop specific objectives, seek feedback, and integrate concepts into curricula. It was determined that the objectives were of value but were being utilized in less than 25% of the material being developed, and that environmental education should be interdisciplinary in character.

Summary

Results of these studies dealing with administrative practices indicate that:

1) better needs surveys must be attempted;

2) services must be restructured to meet the identified needs;

3) improved evaluation is needed; and

4) key administrators and top level managers must be more immediately involved in the development and evaluation of environmental education programs.

XI. Facilities and Sites

The location in which environmental education takes place is of prime importance. Studies have been conducted concerning the requirements of such sites, their development, and related planning.

Jostad (1972) presented a practical approach to site selection in her manual for environmental education and lists as criteria for assessing the appropriateness of a particular site for an outdoor classroom as: (1) uniqueness, (2) feasibility, and (3) ability to withstand the impact of use.

In determining features to be included in a nature trail designed for public use, Cherem (1973) used a picture study of the things most frequently photographed by nature trail users (visitor employed photography). It was determined that all photographs taken by hikers could be placed in one or two categories: "thematic"--flowers, animals, etc.; or "universal"--trail scenes. Nodes of similarity can be identified as a guide to the placement of trails and teaching stations.

The American Camping Association (1964) examined factors of camp environment from the point of view of the psychologist and the camp director to determine relevant factors for study. Research methods currently being utilized in the areas of staff selection, camper attitudes, site management, and administrative programming were discussed and problems for the camp researcher were defined.

Environmental Interpretation

Environmental interpretation is a field that has gained prominence in the past few years. Of the studies done in the field, emphasis has been on planning and operation of nature centers and assessment of visitor attitudes. Some research has been conducted on curriculum development related to on-site features and facilities.

Interpretive Centers

The studies reviewed reflect the belief that facilities are on the increase and trends are expected to continue in that direction. Planning is also a major emphasis.

The educational and administrative planning and development of an environmental studies center were illustrated by Meyer (1972) in reference to the potential of an area near Sydney, Australia as the site for a field studies center. Criteria to be met by a potential site were enumerated, including a survey of biological and cultural resources within and adjacent to the selected area and the criteria to be used in planning the location of buildings and trails. The evolution of the center to allow use by day visitors, and later by residential courses, was described. Parallel

stages in the development of curricula and instructional materials were also considered briefly.

Shomon (1974) analyzed new roles for nature centers and discussed some planning principles for the centers. New principles discussed included: (1) planning the center as an integral part of urban greenspace needs, (2) planning for general and also specific publics, (3) considering the carrying capacity and zoning appropriately, (4) limiting capacity but still providing quality experiences, (5) buffering protection of the site, and (6) integrating with local and regional planning.

An earlier study by Shomon (1962) defined the composition of a nature center. He concluded that three principal elements make up a nature center: (1) land, (2) buildings, and (3) people. Shomon also described how a nature center can be built through a process of logical developments in community organizations and governments.

Shelnutt (1973) developed a plan for an outdoor farm site to serve educational purposes for students from an urban setting. Such an area provided an appropriate atmosphere to demonstrate projects relating to a farm and the urban setting and to teach environmental sciences and ecology. Included in the document are plans, proposed costs, and a model evaluation process.

Attitude/Behavior in Museums and Parks

Of historic interest are two studies done on museum visitor behavior fifty years ago.

Robinson (1928) observed the behavior of museum visitors for several years in the period prior to 1928. He concluded that there was a need for pamphlets that were better prepared than the usual guide books, that museum directors should become experimental psychologists, and that museums should undertake behavior inventories.

Porter (1938) investigated whether the casual visitor followed a sequence of exhibits at the Peabody Museum of Natural History in the order intended, how much time he spent studying the exhibits, how often he read the labels, and whether this arrangement delayed "museum fatigue". When the records were examined it was discovered that the average visitor took the reverse of the route that was planned, that 24% of the exhibits were examined, and that 10% of the labels were read. Porter concluded that mere juxtaposition of exhibits in a logical sequence does not guarantee their examination by the casual visitor in the order intended, and that visitors benefited by the use of leaflets.

DeBorhegyi and Hanson (1968) studied visitor response to variations made on a central anthropological theme in the Milwaukee Public Museum. Visitor response to concepts versus specifics, extensive versus minimal labeling, many specimens versus a few selected pieces, color versus monochrome presentations were analyzed. Also analyzed were the factors influencing information retention. Included in the study were participant characteristics, reasons for visiting the museum, manipulation of museum

space, traffic and use patterns, visitor communication, and the planning and evaluation of exhibits.

Field and Wagar (1973) discussed visitor behavior and interpretation in parks. After researching the subject, they concluded: (1) visitors are diverse, (2) visitors anticipate a relaxed and enjoyable atmosphere, (3) interpretive information must be rewarding, (4) interpretive information must be understood, and (5) the effectiveness of interpretation must continually be evaluated. They also stated that the objectives of an interpretive program must be defined prior to the selection of interpretive methods.

Summary

The eight reported studies attempted to investigate and delineate factors affecting program success and visitor response. Several useful approaches ranging from procedures utilized by Shomon and the National Audubon Society to the techniques employed by the Milwaukee Public Museum appear to be worthy of replication in a variety of settings. While few studies exist on facility and site development in relation to environmental education specifically, the studies by Cherem utilizing visitor employed photography and the work conducted by the American Camping Association provide useful approaches.

XII. Environmental Communications

Research in the relatively new field of environmental communications has been identified since 1971. The five studies reported below compare the effectiveness of communication through media versus normal classroom communication, and describe basic environmental communication methods.

A pilot study was conducted by Voelker (1973) among sixth- and seventh-grade students from average and low socioeconomic neighborhoods in an urban-industrial community, and fifth and sixth graders from a small agricultural-industrial community. The material presented consisted of science concepts centered around an environmental problem, with accompanying pictorial communications to highlight certain concepts. Pre- and post-tests indicated a number of significant differences between the groups. Child reaction to the organization of the material seemed to be an important factor in learning capacity. Procedures for development of instructional materials based on the results of the research were suggested.

Carmichael (1974) created a programmed environment with projected images and electronic media. It provided either a simulation of reality or compressed time-space multi-image, multi-sensory experience. Cognitive learning and learning in the affective domain through environmental communications were established and examined in relation to other theories of learning and communication. Carmichael's study provides a philosophical and theoretical basis for future research in environmental communications.

Brady (1972) compared the effectiveness of field trips and media in teaching environmental biology. The test group was given a set of behavioral objectives before each of 8 two-hour field trips. The control group was exposed to the same concepts through the use of media. The results indicated that, due to significant differences between pre- and post-test scores, both methods were successful in presenting selected environmental concepts. Both methods achieved positive attitude changes toward current environmental problems; neither method was more successful than the other.

Witt (1973) reported on communication concepts applicable for science and environmental communication. The roles of scientific writers and outdoor writers were considered, as well as the roles of environmental agencies. The problem that all feedback flows to the wrong people was discussed and solutions were proposed.

Sellers and Jones (1973) studied the type of people that did not use mass media as a source of information about the environment. They found that members of a conservation group consult their own organization or another conservation group for information about environmental issues. Only 1% of the members polled consult radio or television. Sellers and Jones also analyzed the problems of environmental reporting and suggested a few solutions.

Mehne (1975) investigated the ability of television environmental public service announcements to educe change in urban secondary students' affective evaluations of environmental concepts. A nonequivalent control group design randomly assigned social studies classes of 400 student subjects to experimental and control samples. Both groups judged 12 environmental concepts against 10 bipolar adjective pairs. A color television stimulus was used and then followed by a post-test of the same 12 environmental concepts in a semantic differential instrument. Results indicated that alternative choice format environmental public service announcements are an effective medium for educing positive change in subjects' affective evaluations of environmental concepts.

Summary

The research results obtained in media-related applications indicate that effective approaches for the transmission of environmental concepts and the influencing of attitudes relating to environmental phenomena exist. Notably the research by Mehne and Carmichael will serve as useful models for further work in this area.

XIII. Recommendations

Based upon research conducted in the recent past, as reported in this volume, a number of recommendations are listed below as a guide to further development of effective environmental education programs and evaluative strategies. For convenience the suggestions are listed by appropriate heading.

Concepts and Programs

1) Updated concept delineation should be accomplished in all areas of environmental concern.

2) Teaching and learning strategies should provide for the development of conceptual structures geared to the needs, interests and abilities of the target audience.

3) Clarification of the usage of the term "environment" should be effected, emphasizing the idea of "environmental management" as being more appropriate for the achievement of environmental education objectives.

4) Continued and expanded use of process and concept learning experiences in program development should be utilized.

5) Curriculum approaches for environmental education need to be further developed; these programs need to be integrated into existing curricula.

6) There is a need for further research in techniques for evaluating environmental education curricula.

Simulation and Modeling

Further development of simulation and gaming strategies for cognitive gain and affective development should be pursued.

Evaluation Instrument Development

1) An inventory is needed for the claims of environmental education programs. These should be rephrased into propositions and hypotheses for subsequent empirical research.

2) An inventory is needed of instruments already developed, including rigorous evaluation of their validity and reliability.

3) National norms for effective assessment of environmental education programs would be useful in evaluating locally developed program efforts.

4) New environmental education programs should use existing reliable and valid evaluation instruments already developed for specific areas.

5) More combination instruments, or combinations of the three techniques of pencil and paper, unobtrusive, and direct observation, should be utilized.

6) A handbook of environmental education evaluation instruments should be developed (see Tables I and II of Evaluation Instruments for suggested format).

7) Studies are needed of the various levels of commitment to act on one's attitudes.

Teacher Attitudes

The small number of subjects in some of the cited research and the inconclusive results in others of the reported surveys tend to reinforce the view that considerable refinement of research technique, expansion of sample size, and involvement of teacher education programs in such investigations are needed. Further investigation of teacher attitudes toward environmental education is also needed.

Camp Programs

There are three areas in which additional research about camp programs is needed: (1) study is needed to demonstrate that camp programs produce a positive change about environmental knowledge, (2) more testing needs to be done to answer the question as to whether any changes brought about by a camp experience are permanent or temporary, and (3) research must be done to determine whether the test instruments used in the resident setting are valid and reliable for research in environmental and outdoor education.

Administration

More research is needed in the field of administration, especially on the role of school superintendents, principals, and other administrators in implementing environmental education programs.

Facilities and Sites

1) Recommended practices for site planning in relation to applied research strategies such as visitor-employed photography are needed to more adequately prepare facilities and sites for environmental learning.

2) Definition of the role the physical environment provides in relation to visitor behavior is needed.

3) Guidelines should be provided for the design and construction of facilities that enhance program success.

4) Procedures should be specified that are appropriate for accommodating a variety of program needs on a single site with traditional facilities.

Environmental Communications

From the studies discussed it is evident that research in the field of environmental communication is just beginning. More research needs to be done in all areas, especially in determining the effectiveness of using media in communicating environmental concepts, in the various uses of media instruction, and the various types of media instruction.

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